IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Atty Dkt. 124-909
C# M#

MARTIN, T. et al. TC/A.U. 1765

Serial No. 10/009,530 Examiner: Anderson

Filed: January 22, 2002 Date: September 2, 2004

Title: METHOD OF FABRICATING A SEMICONDUCTOR DEVICE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

RESPONSE/AMENDMENT/LETTER

This is a response/amendment/letter in the above-identified application and includes an attachment which is hereby incorporated by reference and the signature below serves as the signature to the attachment in the absence of any other signature thereon.

☒ **Correspondence Address Indication Form Attached.**

Fees are attached as calculated below:

Total effective claims after amendment **2** minus highest number previously paid for **20** (at least 20) = 0 x $ 18.00	$	0.00
Independent claims after amendment **1** minus highest number previously paid for **3** (at least 3) = 0 x $ 86.00	$	0.00
If proper multiple dependent claims now added for first time, add $290.00 (ignore improper)	$	0.00
Petition is hereby made to extend the current due date so as to cover the filing date of this paper and attachment(s) ($110.00/1 month; $420.00/2 months; $950.00/3 months)	$	0.00
Terminal disclaimer enclosed, add $ 110.00	$	0.00
☐ First/second submission after Final Rejection pursuant to 37 CFR 1.129(a) ($770.00) ☐ Please enter the previously unentered , filed ☐ Submission attached	$	0.00
Subtotal	$	**0.00**
If "small entity," then enter half (1/2) of subtotal and subtract ☐ Applicant claims "small entity" status. ☐ Statement filed herewith	-$	0.00
Rule 56 Information Disclosure Statement Filing Fee ($180.00)	$	0.00
Assignment Recording Fee ($40.00)	$	0.00
Other:		**0.00**
TOTAL FEE ENCLOSED	$	**0.00**

The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140. A duplicate copy of this sheet is attached.

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NIXON & VANDERHYE P.C.
By Atty: Arthur R. Crawford, Reg. No. 25,327

Signature: _____

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

MARTIN, T. et al. Atty. Ref.: 124-909; Confirmation No. 4032

Appl. No. 10/009,530 TC/A.U. 1765

Filed: January 22, 2002 Examiner: Anderson

For: METHOD OF FABRICATING A SEMICONDUCTOR DEVICE

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September 2, 2004

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

RESPONSE

The request to suspend action as included in the RCE filed July 30, 2004 is hereby withdrawn to allow prompt consideration of this submission and the Information Disclosure Statement filed August 11, 2004.

This responds to the Official Action of January 30, 2004 and the rejection of claims 6 and 7 as modified and explained in the Advisory Action of July 13, 2004.

This rejection is based on a spurious combination of Goodhue, Moermann and Colas. The examiner has found the various pieces of the invention in different documents and is reading them together without any suggestion in the prior art to do so.

Our law is clear: there must be a teaching to combine in the applied prior art in order to do so. The U.S. Court of Appeals for the Federal Circuit has stated that "[t]he mere fact that the prior art may be modified in the manner suggested by the examiner

does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992) (citing *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984)). Although this statement is couched in terms of modifying the prior art the Board of Appeals and Interferences, in a non-precedential decision (67 USPQ2d 1633 at 1635) held that the mere fact that teachings found in the prior art could be combined as proposed by an examiner does not make the combination obvious "absent some teaching, suggestion or incentive supporting the combination." *Carella*, 804 F.2d at 140, 231 USPQ at 647 (citing *ACS Hosp. Syss., Inc.*, 732 F.2d at 1577, 221 USPQ at 933).

Goodhue primarily shows use of MBE with temperature gradients. Column 10, lines 50-53 state: *"**With suitable heaters**, it is contemplated that those skilled in the art will be able to implement the invention without undue experimentation in MOCVD and CBE reactors."* (emphasis added). Goodhue teaches the use of temperature gradients for growing tapered layers, whatever the growth process. Goodhue does not suggest that the temperature gradients could or should be dispensed with. The core of Goodhue's invention is the temperature gradients -- he does not say "the basis of my invention is the use of temperature gradients, however you could dispense with the temperature gradients and try something else and therefore any other way of growing tapered layers that you may think of is obvious" as the Official Action seems to suggest. The proposed modification cannot change the principle of operation of a reference. *In re Ratti*, 123 USPQ 349 (CCPA 1959); MPEP §2143.01. However, the examiner's proposed modification would effectively change the principle of operation of Goodhue.

Moermann is a comprehensive review paper on epitaxial growth of tapered layers. This paper was published in 1997, thirteen years after one of the first papers reporting the CBE process (Tsang, Applied Physics Letters 45, 1984, p1234 -- cited in the recent IDS of August 11, 2004). If CBE was such an obvious process for the epitaxial growth of tapered layers, why it is that there is not a single mention of CBE, in any context whatever, anywhere in Moermann?

There is no suggestion anywhere in the prior art to modify the process that is described on p1314 of Moermann, i.e. MOVPE + shadow masking, such that the MOVPE is replaced by CBE.

Colas describes use of a silicon dioxide DEPOSITED mask of varying width, together with MOCVD, to grow a tapered epitaxial layer. There is no suggestion to use CBE instead of MOCVD, nor to use a mechanical shadow mask instead of a deposited mask.

An important advantage of the present invention is that it provides an epitaxial process whereby waveguides having a core layer which changes in thickness by *several microns* may be grown in a single epitaxial growth step, *with good qualify taper regions which are highly planar, whatever the orientation of the crystallographic axes of the taper material.* This latter feature results in low optical loss and optical mode size conversion without affecting other mode properties. Although other epitaxial processes for growing waveguides with vertically tapered core layers are known (e.g. in Moermann) and also have the advantage of lower contamination compared to etch-and-regrowth processes, the epitaxial processes in the prior art are not suitable for growing *large thickness-difference* tapers (e.g. several microns) having *highly planar transition regions.* For example, in Goodhue it is explained at column 4, lines 60 and 61 that the core layer has 12 quantum wells, and at column 5, line 68 and column 6, lines 4 & 9 that the well and barrier thicknesses change from 13nm and 22nm respectively in the hotter areas of the substrate to 5nm and 11nm respectively in the cooler regions. Therefore the total thickness of the core layer changes from

(12 x 13nm) + (11 x 22nm)=398nm

to

(12 x 5nm) + (11 x 11nm)=181nm

i.e. a thickness change of only 217nm. This thickness change occurs over a distance of ~700 μm (see Figure 3 of Goodhue, which shows that the thickness transition occurs between lateral positions of 0.3mm and 1.0mm).

In contrast, in the example of applicants' invention, a thickness change of 4 μm is achieved over a distance of 1000 μm with a highly planar taper (page 7, lines 15 to 17 of the specification). This sort of *large-thickness, highly planar taper* is not obtainable by use of MOVPE/MOCVD and shadow masking because MOVPE/MOCVD is not a ballistic growth process (whereas CBE *is* a ballistic growth process). It is therefore not possible to grow a high quality *planar, thick* taper using this method, because molecules involved in MOVPE/MOCVD growth get underneath the mask during growth and produce growth in geometrically-shadowed regions of the substrate.

The present invention is therefore not merely an alternative method of producing a vertically tapered waveguide -- it enables thick, highly planar tapers to be grown epitaxially. This is a problem not addressed or even mentioned in the prior art.

Other problems with MOVPE/MOCVD and shadow masking are explained in applicants' specification at page 4, lines 11 to 18, these also being solved by the present invention.

The use of an oxide coated mask in the present invention is essential because the oxide coating prevents material growth on the mask. Such growth would adversely affect the shadowing effect of the mask, resulting in a non-planar tapered region which would give rise to greater optical loss and poorer mode conversion in the finished waveguide. Moreover, material growth on the mask would lead to a method of device manufacture which is unscalable to different device dimensions. The method of claim 6 is applicable to devices for operation at various optical wavelengths. The avoidance of material growth on the mask in the method of claim 6 means that the same mask may be used for many growth runs, reducing the cost of the process and time lost in fabricating and loading new masks into the Ultra-High Vacuum (UHV) chamber.

The examiner is requested to reconsider the rejection of claims 6 and 7 bearing in mind there is no suggestion in the references themselves – a legal requirement necessary to base a rejection under 35 USC §103(a) – the references could or should be combined

and also take into account the two documents cited in the Information Disclosure Statement filed August 11, 2004.

Reconsideration and favorable action are solicited.

Respectfully submitted,

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